

Global Tropospheric Experiment Pacific Exploratory Mission- West A (GTE PEM West A) Langley ASDC Data Set Document



Summary

This document provides information on data products obtained during the GTE Pacific Exploratory Mission-West A atmospheric science expedition conducted over the western Pacific during September and October 1991. The objective of the mission was to investigate the atmospheric chemistry of ozone and sulfur over the northwestern Pacific. Measurements were made primarily by investigators' instruments located on the NASA Ames Research Center DC-8 airborne laboratory. Also provided are a list of principal investigators, a brief summary of measurement techniques and a list of publications.

This document provides information for the following PEM West A data sets:

DC-8 Platform

gte_pemtb_p3mXX.zip:

DC-8 Aircraft Data for flight XX

gte_pemwa_jpg_msn_04.zip:

Time series and altitude plots of *in situ* measurements on DC-8

NIES Aircraft Platform

gte_pemwa_ground_pc.zip:

Measurements of O₃, CO, Hydrocarbons, SO₂, and navigational data aboard the NIES aircraft during an intercomparison flights with the DC-8 aircraft

Ground based Measurements

gte_pemwa_ground_ak.zip:

O₃ concentration at Tsushima and Okinawa, Japan, and O₃ and CO concentrations at Oki, Japan

gte_pemwa_ground_ja.zip:

Measurements of NO at Oki, Japan

gte_pemwa_ground_pr.zip:

High volume aerosols collection and analysis of major ions and trace elements at Ken-Ting, Taiwan, Shemya, Alaska, Oaha, Hawaii, Midway Island, Okinawa, Japan, Hong Kong, and Cheju Island, Korea.

gte_pemwa_ground_ro.zip:

Measurements of HCs, NO, NO_x, NO_y, SO₂, HNO₃, NO₃⁻, and SO₄⁻ at Lin An, Peoples Republic of China;

gte_pemwa_ground_zh.zip:

Measurements of NO NO₂ NO_x, SO₂, NO_y, and O₃, Black Carbon at Lin An, Peoples Republic of China;

Acknowledgment

The investigators involved in the PEM West A mission were funded by NASA. The funded investigators, their organization and their grant, agreement, or contract were:



Area	Investigator	Organization	Grant
Aircraft	A. Bandy	Drexel U	NAG-1-1224
	J. Bradshaw	GA Tech	NAG-1-1213
	E. Browell	NASA Langley	N/A
	G. Gregory	NASA Langley	N/A
	B. Heikes	U of Rhode Island	NAG-1-1222
	S. Rowland	U of California-Irvine	N/A
	G. Sachse	NASA Langley	N/A
	H. Singh	NASA Ames	N/A
	R. Talbot	U of New Hampshire	NAG-1-1233
Ground	R. Arimoto	U of Rhode Island	NAG-1-1225
	J. Prospero	U of Miami	NAG-1-1229
Modeling	J. Merrill	U of Rhode Island	NAG-1-1235
	D. Davis	Georgia Tech	NCC-1-148
	R. Newell	Mass Inst of Tech	NAG-1-1252
	S. Liu	NOAA Boulder	N/A

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1. Collection Overview

a. Collection Contents

Aircraft data sets are available for each investigation for each flight. Airborne measurements were made at generally constant altitude (i.e. "survey" flights) over the North Pacific Ocean and between major sites and multi-altitude flights (i.e. "intensive" flights) occurred around the intensive sites and closer to Asia. Flight missions were conducted during PEM West A from September 16 through October 22, 1991. Section 4.b lists the flight. The duration, altitude range, ascent and descent rate, and flight path for each mission varied depending on mission objectives and environmental conditions. Further information about the measurement region and time frame may be found in the Journal of Geophysical Research, Vol. 101, No. D1, 1641-1653, 20 January 1996.

Data Set Introduction

This data set contains the DC-8 data submitted to the GTE data archive by the PEM West A investigators listed in Section 1.d. Included are the atmospheric chemistry, meteorological and navigational data recorded aboard the NASA DC-8 airborne laboratory. Japanese Cessna 404 aircraft flight 13 intercomparison data, ground site data, modeling products, trajectories and merged data sets are not contained in this archive. These data products can be found at the [GTE data archive](#).

Summary of Parameters

The atmospheric species and other parameters measured are listed in Hoell et al., [1996] Also listed for each are the name and affiliation of



the principal investigator.

b. Related Data Collections

PEM West A investigators have individually reported the results of their investigations in the Journal of Geophysical Research, Vol. 101, No. D1, January 20, 1996. Also see Atmospheric Chemistry of the East Asian Northwest Pacific Region, Akimoto, H. et al., in The Global Atmospheric-Biospheric Chemistry, edited by R. G. Prinn, pp. 71-82, Plenum Press, New York, 1994 for related discussions.

There are data sets available from the Langley ASDC for the 13 other GTE missions conducted from 1983 to 2001. See the [GTE home page](#) for a description of the available data.

c. Title of Investigation

Global Tropospheric Experiment Pacific Exploratory Mission West A (PEM West A)

d. Investigator Name and Title

If the person is known to be retired, deceased or no longer at the organization originally responsible for the investigation, it is noted and the contact information may be omitted. The contact information provided was current during the mission, but may no longer be current.

DC-8 Measurements Investigators

Investigator Area	Investigator Information
DMS, OCS, SO ₂	Alan R. Bandy Drexel University Department of Chemistry 32 nd and Chestnut Street Philadelphia PA 19104 Telephone: 215-895-2640 Fax: 215-895-1980 E-mail: bandyar@drexel.edu
Airborne Meteorological/Position Data	John D. Barrick MS 483 NASA Langley Research Center Hampton VA 23681-0001 Telephone: 757-864-5831 Fax: 757-864-5841 E-mail: john.d.barrick@nasa.gov
Nitric Oxide, Nitrogen Dioxide, NO _y	John Bradshaw (Principal Investigator, Deceased) Scott Sandholm (Co-Investigator) Georgia Institute of Technology Earth and Atmospheric Sciences Baker Building, Room 107 923 Dalney Street Atlanta GA 30332-0340 Telephone: 404-894-3895/3824 Fax: 404-894-5073 E-mail: ss27@prism.gatech.edu
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in-situ Ozone and Aerosol Size Distribution	Gerald L. Gregory (retired)



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H ₂ O ₂ , CH ₃ OOH	Brian G. Heikes University of Rhode Island Graduate School of Oceanography South Ferry Road Narragansett RI 02882-1197 Telephone: 401-874-6683 Fax: 401-874-6898 E-mail: bheikes@gso.uri.edu	
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PAN, PPN, C ₂ Cl ₄	Hanwant Singh NASA Ames Research Center Singh Group Mail Stop 245-5 Moffett Field CA 94035 Telephone: 415-604-6769 Fax: 415-604-3265 E-mail: hanwant.b.singh@nasa.gov	
Aerosol Composition, Nitric Acid, Organic Acids	Robert W. Talbot University of New Hampshire Institute of Earth, Oceans, Space Morse Hall Complex Systems Research Center Durham NH 03820 Telephone: 603-862-1546 Fax: 603-862-0188 E-mail: rwt@christa.unh.edu	
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e. Technical Contact(s)

The following persons have more specialized knowledge about the data in the data sets or in their field or general knowledge about the mission, its execution and the data sets.

Investigator or Knowledge Area	Investigator and Contact Information	
Non-methane hydrocarbon measurements aboard the DC-8	Donald Blake University of California-Irvine Department of chemistry Irvine CA 92717 Telephone: 714-856-4195 Fax: 714-725-2905 E-mail: drblake@uci.edu	
Measurements for DMS, OCS SO ₂	Donald C. Thornton Drexel University Department of Chemistry 32 nd and Chestnut Street Philadelphia PA 19104	
PEM West A Mission Co-Scientists	Douglas D. Davis Georgia Institute of Technology School of Earth and Atmospheric Sciences Room 108 221 Bobby Dodd Way Atlanta GA 30332-0340 Telephone: 404-894-9565 Fax: 404-894-1993 E-mail: dd16@prism.gatech.edu	Shaw Liu (no longer at Georgia Tech) Georgia Institute of Technology
PEM West A Program Manager	Robert J. McNeal (retired) NASA Headquarters	
PEM West A Project Manager	James M. Hoell, Jr. (retired) NASA Langley Research Center	
PEM West A Mission Meteorologist	Reginald Newell (deceased) Massachusetts Institute of Technology	
PEM West Associate Mission Meteorologist	Mark Shipham (no longer at NASA) NASA Langley Research Center	
PEM West A Expedition Manager	Richard J. Bendura (retired) NASA Langley Research Center	
DC-8 Aircraft Manager	Leo DeGreef NASA Ames Research Center Mail Stop 211-12 Moffett Field, CA 94035 Telephone: 415-604-5342 Fax: 415-604-3885	Airborne Science Program Office MS D1623H Edwards, CA 93523-0273 Phone: (661) 276-7453 Fax: (661) 276-3719
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PEM West Data Manager	Joseph W. Drewry (retired) NASA Langley Research Center	

2. APPLICATIONS AND DERIVATION



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Potential usage and applications of the described data sets can be seen in the articles that comprise the Journal of Geophysical Research PEM West A Special Section (Vol.101, No. D1 January 20, 1996), the 1992 AGU Western Pacific Geophysics Meeting, the 1993 Conference of the International Global Atmospheric Chemistry (IGAC) Project, and the 1994 Conference of the International Global Atmospheric Chemistry (IGAC) Project.

a. Calculated Variables

For convenience of the users, the calculated variables below are provided.

Mach Number, M:

$$M = \sqrt{5 * \left[\left(\frac{Q_c}{P_s} + 1 \right)^{\frac{2\gamma}{\gamma-1}} - 1 \right]}$$

M = Mach Number
P_s = Static Pressure
Q_c = Differential Pressure

True Air Speed, TAS:

$$TAS(kts) = M * a = M * 38.96695 * \sqrt{T_s}$$

TAS = True Air Speed (knots)
T_s = Static Air Temperature (°K)
M = Mach Number
a = Speed of Sound

Static Air Temperature, T_s:

$$T_s(^{\circ}K) = \frac{T_T}{\left[1 + M^2 * \left(\frac{\gamma - 1}{2} \right) \right]}$$

T_s = Static Air Temperature (°K)
T_T = Total Air Temperature (°K)
γ = 1.4, ratio of specific heat of air at constant pressure and volume

Potential Temperature, θ:

$$\theta(^{\circ}K) = T_s * \left(\frac{1000}{P_s} \right)^{0.2857142}$$

θ = Potential Temperature (°K)
T_s = Static Air Temperature (°K)
P_s = Static Pressure (mb)

Vapor Pressure, e(mb):

$$e_{\text{water}} = 10^{[23.5518 - (2937.4/T)] * T^{(-4.9283)}}$$

$$e_{\text{ice}} = 10^{[11.4816 - (2705.2/T)] * T^{(-0.32286)}}$$

T = Static Air Temperature (°K) for Saturation Vapor Pressure

or

T = Dew/Frost Point (°K) for Partial Pressure of Water Vapor

Note:

StatTempDegK and ProjDP parameters recorded in the P-3B data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively.

TSDEGC and ProjDP parameters recorded in the DC-8 data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively. Also notice in the DC-8 data set there is a redundant static air temperature measurement, TSCALC, which is calculated by DADS. Although TSDEGC and TSCALC track closely they can diverge by ?0.8° at the low and high ends of the measurement range.

Specific Humidity, q:

$$q(g/kg) = \frac{0.622 * 10^3 * e}{(P_s - 0.377e)}$$

$$q(ppmw) = \frac{0.622 * 10^6 * e}{(P_s - 0.377e)}$$



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Relative Humidity, %:

w.r.t. water,

$$RH_{\text{water}} = \frac{e_{\text{water}}}{e_{s_{\text{water}}}} * 100$$

w.r.t. ice,

$$RH_{\text{ice}} = \frac{e_{\text{ice}}}{e_{s_{\text{ice}}}} * 100$$

b. Graphs and Plots

Interested readers should see the Journal of Geophysical Research, Vol. 101, No. D1, January 20, 1996, and documents referenced therein, for plots and the results of analyses of data.

3. DATA DESCRIPTION AND ACCESS

a. Format

See the [GTE Data Format Document](#).

b. Data Organization

Granularity

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary. Aircraft data sets are available for each investigation for each flight.

c. Data Collection Status and Plans

All DC-8 aircraft data for the mission are contained in the archive. No additional data products relevant to the PEM West A archive are anticipated.

d. Data Access

This data is available online through the [GTE Data and Information table](#) or on a [CDROM via the LaRC ASDC](#) and from the [GTE data archive](#).

e. Data Archive Center

The Atmospheric Science Data Center at NASA's Langley Research Center.

Contacts for Data Center or Data Access Information:

User and Data Services Group
Atmospheric Science Data Center
MS 157D
Langley Research Center
Hampton, VA 23681 USA
Phone: 757-864-8656
Fax: 757-864-8807
E-mail: support-asdc@earthdata.nasa.gov
Internet: <http://eosweb.larc.nasa.gov>

f. How to Cite the Data Collection

Publication of a portion(s) of the data archive should acknowledge the principal investigator(s) responsible for the data by referencing the appropriate manuscript in the Journal of Geophysical Research, Vol. 101, No. D1, January 20, 1996.



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4. DATA CHARACTERISTICS

a. Study Area

Airborne measurements were made over the western Pacific. A more detailed description of the surface level environmental characteristics for the experiment region is provided in the individual papers for each investigation included in the Journal of Geophysical Research, Vol.101, No. D1, January 20, 1996. Additional information may be found in other publications authored by the principal investigators or on the [GTE home page](#).

Spatial Coverage

Flight missions were conducted during September and October, 1991. The duration, altitude range, ascent and descent rate, and flight path of each mission varied depending on mission objective and environmental (weather) conditions. The nominal air speed ranged from 480 knots (approximately 552 mph) at 12.6 km altitude to 240 knots (approximately 276 mph) at 0.34 km.

Data Set Name	Min Lat	Max Lat	Min Lon	Max Lon
Measurements aboard the DC-8 aircraft	0.4 N	60.8 N	175.3W	176.2E

Spatial and Temporal Resolution

Resolution varies for each measurement. See Hoell et al., [1996] for resolution of measurements made aboard aircraft.

Grid Description

No data gridding or binning of data to a geographic grid occurred during data processing.

b. Temporal Coverage

Eighteen aircraft missions were conducted from September 16 to October 22, 1991.

Measurement Platform	Begin Date	End Date
DC-8 Aircraft	9/7/91	10/22/91

c. Parameter or Variable

Not all of the parameters are in each data set granule. Also, the ranges vary between data sets and between granules within each data set. Species measured are given in Hoell et al., [1996].

Parameter Description

The variables measured are standard atmospheric chemical and meteorological species requiring no further elaboration here.

Unit of Measurement

The units of measure vary widely depending on species and measurement environment and are addressed in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 101, No. D1, January 20, 1996.

Parameter Source



The instruments used in making the measurements are listed in Hoell et al., [1996].

Parameter Range

The ranges of data vary widely depending on species and measurement environment and are addressed in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 101, No.D1, January 20, 1996. The range (min/max) for each parameter can be found in the header record for each data file.

Sample Data Record

The [GTE Data Format Document](#) contains examples of each data set type.

d. Error Sources:

The sources of error vary widely depending on species and measurement environment and are addressed in the individual papers for each investigation included in the PEM West A special issue/section of the Journal of Geophysical Research, Vol.101, No. D1, January 20, 1996, and/or the papers referenced in that publication. For further details, contact the responsible principal investigators (see Section 1.d) and review the header for each data record. Instrument accuracy and precision, listed by parameter, can be found in Hoell et al., [1996].

5. USAGE GUIDANCE

a. Known Problems with the Data

None reported for the current archive version. See the comment sections in the individual data files and the readme files submitted by the individual investigator.

b. Future Modifications and Plans

The data sets submitted to the ASDC are considered final and no further updates are planned. However, modifications will be considered if requested by the investigators or otherwise justified.

6. ACQUISITION MATERIALS AND METHODS

Details of data acquisition and materials are addressed in the Journal of Geophysical Research PEM West A Special Section (Vol.101, No. D1 January 20, 1996), the 1992 AGU Western Pacific Geophysics Meeting, the 1993 Conference of the International Global Atmospheric Chemistry (IGAC) Project, and the 1994 Conference of the International Global Atmospheric Chemistry (IGAC) Project.

7. REFERENCES

AGU Western Pacific Geophysics Meeting, Hong Kong, 17-21 August 1992.

Conference of the International Global Atmospheric Chemistry (IGAC) Project, Eilat, Israel, 18-22 April, 1993.

Second Conference of the International Global Atmospheric Chemistry (IGAC) Project, Fuji-Yoshida, Japan, 5-9 September 1994.

PEM West A Special Section, Journal of Geophysical Research, Vol.101, No. D1 January 20, 1996.

[GTE Bibliography](#)

Hoell, J. M., D. D. Davis, S. C. Liu, R. Newell, M. Shipman, H. Akimoto, R. J. McNeal, R. J. Bendura, and J. W. Drewry, Pacific Exploratory Mission-West A (PEM-West A): September-October 1991, J. Geophys. Res., Vol. 101, No. D1, 1641-1653, 20 January, 1996.

8. ACRONYMS

AGU - American Geophysical Union



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ASDC - Atmospheric Science Data Center
CMDL - Climate Monitoring and Diagnostics Laboratory
DADS - Data Acquisition and Display System
EOSDIS - Earth Observing System Distributed Information System
GTE - Global Tropospheric Experiment
IGAC - International Global Atmospheric Chemistry
IMS - Information Management System
NASA - National Aeronautics and Space Administration
NIES - National Institute for Environment Science
NOAA - National Oceanic and Atmospheric Administration
PEM - Pacific Exploratory Mission
ProjDP - Project Dew Point
TSCALC - Static temperature, calculated by DADS
TSDEGC - Static temperature, measured directly, in Celsius

9. Document Information

- **Creation Date:** November 2003
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